


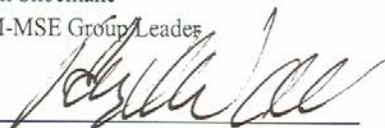


CRITERION 403

BOILERS

SIGNATURES

	<u>1-18-06</u>	FM-MSE	667-8380
Joe D. Gonzales	Date	Group	Phone Number
Criterion Author			
	<u>1-19-06</u>	FM-MSE	667-3360
Todd Siverling	Date	Group	Phone Number
Maintenance Engineering Team			
	<u>1/19/06</u>	FM-MSE	667-4917
Don Shoemaker	Date	Group	Phone Number
FM-MSE Group Leader			
	<u>1-20-06</u>	FM-DO	667-6131
Ray Wallace	Date	Group	Phone Number
FMD Division Leader			

RECORD OF REVISIONS

Revision No.	Date	Description
0	0910/98	Initial Issue
1	03/01/00	This revision reflects the conversion from a WordPerfect document into a Microsoft Word document and additional clarification of how to develop criteria.
2	01/08/02	This revision includes <ul style="list-style-type: none">• The addition of a Table of Contents,• The use of Basis Statements in Sections 6, 7, and 9,• Incorporation of ORPS and NRC “Lessons Learned” from 1/95 to 2/2/2000.• Incorporation of comment and rewording requested by the Maintenance Subcommittee.
3	09/23/05	This revision includes: <ul style="list-style-type: none">• Added new definition of pigtail loop (not originally included in document)• Correct grammar and definition (e.g. “buckle up”) throughout document• Updated boiler code information throughout document• Updated Water and Air Quality Group information
4	1/19/06	This revision includes: <ul style="list-style-type: none">• Deleted note in Section 6.2.3.1. This will clarify preventive maintenance requirements.• Removed LIRs that have been rescinded or cancelled.

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CRITERION 403**BOILERS****1.0 PURPOSE**

The purpose of this Criterion is to establish the minimum requirements and best practices for operation and maintenance of all unmanned Boilers in service at LANL.

This document addresses the requirements of LIR 230-05-01(Ref 10.1), "Operations and Maintenance Manual."

Implementation of this Criterion satisfies DOE Order 430.1A (Ref. 10.2), for the subject equipment / system. DOE Order 430.1A (Ref 10.2) "Life Cycle Asset Management," Attachment 2 "Contractor Requirements Document," Paragraph 2, Sections A through C, which in part requires UC to "...maintain physical assets in a condition suitable for their intended purpose" and employ "preventive, predictive, and corrective maintenance to ensure physical asset availability for planned use and/or proper disposition." Compliance with DOE Order 430.1A is required by Appendix G of the UC Contract.

2.0 SCOPE

The scope of this Criterion includes the routine inspection, testing and preventive and predictive maintenance of unmanned boilers at all nuclear and non-nuclear LANL facilities. This Criterion does not address corrective maintenance actions required to repair or replace equipment.

Note: The TA 3-22 and TA 21-357 Steam Plant Boilers are not subject to the requirements of this document. These two plants are manned on a continuous basis. Autoclaves and steam generators used for programmatic processes are also exempt from this criterion.

3.0 ACRONYMS AND DEFINITIONS**3.1 Acronyms**

AR	Administrative Requirements
ASME	American Society of Mechanical Engineers
BHW	Boiler, Hot Water
BS	Boiler, Steam

CFR	Code of Federal Regulations
CSD-1	Controls and Safety Devices for Automatically Fired Boilers (An American National Standard under ASME)
DOE	Department of Energy
LIG	Laboratory Implementing Guidance
LIR	Laboratory Implementing Requirement
LPR	Laboratory Performance Requirement
MAWP	Maximum Allowable Working Pressure
MSDS	Material Safety Data Sheet
NBIC	National Board Inspection Code
O&M	Operations and Maintenance
PPE	Personal Protective Equipment
PP&PE	Personal Property and Programmatic Equipment
RP&IE	Real Property and Installed Equipment
SSC	Structures, Systems, and Components
UC	University of California
UMC	Uniform Mechanical Code

3.2 Definitions

Atmospheric Burners. Atmospheric burners depend upon natural draft for combustion air. There are several types of atmospheric burners, most of which fall into the general classification of single or multiport. (Reference 10.7)

ASME Code. The American Society of Mechanical Engineers Boiler and Pressure Vessel Code establishes Recommended Rules for the Care and Operation of Heating Boilers and also the Rules of Safety governing the Design, Fabrication and Inspection of Boilers and Pressure Vessels. (Reference 10.7)

Blowdown. The water removed under pressure, from a boiler, through the bottom drain valve(s), to eliminate sediment and reduce total solids. **Note:** Blowdown of float-operated low water fuel cut-offs is also done for this reason. If sludge accumulates and builds up under the float the device may not be able to see an actual low water condition to shut off the burner. (Reference 10.7)

Boiler. A closed vessel used for heating water or for generating steam for process and space heating, by direct application of heat from combustible fuels or electricity. The following boiler classifications are found at LANL.

- **High Pressure Steam Boiler.** A boiler in which steam is generated at pressures exceeding 15 psi. The above mentioned are designated as BSs at LANL.
- **Low Pressure Steam Boiler.** A boiler in which steam is generated at pressures not exceeding 15 psi. The above mentioned are also designated as BSs at LANL.
- **Low Temperature Hot Water Heating Boiler.** A boiler in which no steam is generated and from which hot water, at temperatures not exceeding 250 degrees F or at pressures not exceeding 160 psi, is circulated for heating purposes, then returned to the boiler. All hot water heating boilers at the laboratory are of this type. The above mentioned are designated as BHWs at LANL. (Reference 10.8)

Boiler Layup. Any extended period of time (summer) during which a boiler(s) is idle and is not expected to operate. Lockout/Tagout boiler(s) and shut-off gas supply. A non-operational steam boiler should be filled to the top with chemically treated feedwater or condensate to minimize corrosion during lay-up. Inactive heating systems, along with boilers, in vacated buildings, should be drained due to danger of freezing. (Reference 10.7)

Boiler Pass. The path of travel of the combustion gases through the full length of boiler including the initial pass in the primary combustion zone. A boiler may have as many as four passes. (Reference 10.14)

Boiler Programmer. A boiler programmer is the mastermind that controls the firing cycle of a boiler. It performs two functions. (1) senses the presence of a flame during pilot and main flame and (2) programs the operation of a burner system so that motors, blowers, ignition and fuel valves are energized only when they are needed, and then in proper sequence. **Note:** Not all boilers have programmers. (References 10.13 & 10.17)

Boiler System: A system comprised of the boiler(s), its controls, safety devices, interconnecting piping, vessels, valves, fittings and pumps. (Reference 10.8)

Breeching. A duct for the transport of the products of combustion between the boiler and the stack. (Reference 10.7)

Condensate. The liquid water formed by the cooling and condensing of steam due to the loss of its heat. Condensate is returned and stored in a condensate storage tank before it is delivered back to the steam boiler by the feedwater pump. (References 10.7 & 10.17)

Conductivity. The measurement of ionizable solids, in solution, expressed in micromhos/cm (MMHOS). Conductivity measurements are used to measure the total dissolved solids, in the water, in steam boilers. (Reference 10.15)

Continuous Blowdown. Water skimmed off near the liquid surface of a steam boiler, through a metering valve, on a continuous basis. This is used to keep total dissolved solids, in the water, within acceptable levels. (Reference 10.15)

Deaerator. Equipment used to remove a majority of the dissolved gases in a steam boiler's feedwater pretreatment cycle. (Reference 10.13)

Expansion Tank. Expansion tanks are used on hot water systems for the expansion of the water when it is heated. An air cushion in the tank is compressed by the expanding water thus maintaining a constant system pressure. (Reference 10.7)

Firetube. A tube(s), in a boiler, having water on the outside and carrying the products of combustion on the inside. (Reference 10.7)

Flame Scanner. A device, found as part of a boiler programmer circuitry, that proves pilot and main flame. The burner should shut off, as a flame failure condition, if no pilot or main flame is detected. (Reference 10.17)

Forced-Draft Fan. A fan, in boilers with power burners, that supplies air for combustion of fuel as well as draft. (Reference 10.13)

Furnace. An enclosed space provided for the combustion of fuel. (Reference 10.7)

Gage Glass. The transparent part of a water gage assembly connected directly or through a water column to the boiler, below and above the waterline, to indicated the water level in a steam boiler. (Reference 10.7)

Handhole. An opening in a pressure part for access, usually not exceeding 6 inches in longest dimension. (Reference 10.7)

Heat Extractors. Spring-like devices inserted in some firetubes to produce a swirling motion of the flue gases to promote heat transfer. Heat extractors are mainly used in, one pass, firetube boilers such as those manufactured by Sellers. (Reference 10.12)

Induced-Draft Fan. A fan, generally mounted on horizontal breeching, that pulls the flue gases out of some boilers, with atmospheric burners, into the stack. Example: TA 50-1 & TA 53-1 C-Wing. (Reference 10.13)

Limit Control. A device, with a manual reset, which shuts down the burner when operating limits are surpassed. (Reference 10.7 & 10.8)

Low Water Fuel Cut-Off. (LWC) A device, most often float-operated, which shuts down the fuel burner when the water level in the boiler drops below its operating level. Two low water fuel cutoffs are required on steam boilers. The primary LWC has a combination condensate feed pump control and an auxiliary control that automatically cuts off the fuel supply if the proper water level is not being maintained. The secondary LWC is set one inch lower than the primary and it causes a safety shutdown, requiring manual reset. **Note:** Even though most hot water heating boilers at LANL have a LWC, by code one is required only on boilers with capacities of 400,000 Btu/hr or greater. (Reference 10.7 & 10.8)

Makeup Water. Water introduced into the boiler, from outside the boiler system, to replace that lost (leaks) or removed from the system. (Reference 10.7)

Manhole. The opening in a pressure vessel of sufficient size to permit a man to enter. (Reference 10.7)

National Board Inspection Code (NBIC). It is the purpose of the National Board Inspection Code to maintain the integrity of boilers and pressure vessels after they have been placed into service by providing rules and guidelines for inspection after installation, repair, alteration and re-rating, thereby helping to ensure that these objects may continue to be safely used. (Reference 10.9)

Operating Control. A device which automatically controls the operation of a fuel burner to maintain the desired temperature or pressure. (Reference 10.7 & 10.8)

pH. A logarithmic scale used to measure the degree of acidity or alkalinity of a solution. The scale runs from 1 (strong acid) to 14 (strong alkali) with 7 (distilled water) as the neutral point. (Reference 10.7)

Power Burners. Power burners are designated to operate with a furnace pressure higher than atmospheric and are equipped with sufficient blower capacity to force products of combustion through the boiler without the help of natural or induced draft. (Reference 10.7)

Pigtail Loop. Each pressure control device on steam boilers should have a pigtail loop, which acts as a steam trap, installed between the controller, and the boiler. This prevents the controllers diaphragm or bellows from seeing any steam, thus preventing damage to it. (Reference 10.14).

Refractory. Brickwork and associated materials, used in some boilers, capable of enduring high temperatures. (Reference 10.13)

Re-tubing. The act of replacing boiler fire/water tubes. (Reference 10.16)

Safety Relief Valve. An automatic pressure-relieving device required by code to be used on hot water heating boilers that is actuated by the pressure generated within the boiler. Valves of this type are spring loaded without full-opening action and have a factory set nonadjustable pressure setting. A safety relief valve set pressure must be equal to or less than boiler Maximum Allowable Working Pressure (MAWP) and its relieving capacity must be equal to or greater than boiler output. (Reference 10.7)

Safety Valve. An automatic pressure relieving device, required by code, to be used on steam boilers. It is actuated by the pressure generated within the boiler and characterized by full-opening pop action. Valves are of the spring-loaded pop type and are factory set and sealed. A safety valve set pressure must be equal to or less than boiler Maximum Allowable Working Pressure (MAWP) and its relieving capacity must be equal to or greater than boiler output. (Reference 10.7)

Scale. A deposit caused by two or more minerals exceeding their solubility product and forming a precipitate. Scale on tubes, tubesheets, etc., reduces efficiency and leads to overheating and possible failure. (Reference 10.7)

Shell. The cylindrical portion of a pressure vessel. (Reference 10.7)

Tubesheet. The end plates with holes, in some boilers, that connect the ends of firetubes. (Reference 10.7 & 10.14)

Watertube. A tube(s), in a boiler, having the water and steam on the inside and heat applied to the outside. (Reference 10.7)

Water Softener. Equipment used to remove the hardness from boiler feedwater. A sodium zeolite water softener uses an ion exchange process to remove calcium and magnesium ions from water and replaces them with sodium. A brine solution and resin beads are part of the system which most water softeners use. (References 10.7 & 10.14)

For additional definitions of boiler components, controls, safety devices, water treatment terms, etc., refer to work smart standard ASME Section VI (Recommended Rules for the Care and Operation of Heating Boilers) and CSD-1 (Controls and Safety Devices for Automatically Fired Boilers).

4.0 RESPONSIBILITIES**4.1 FM-Maintenance Support and Engineering (MSE)**

4.1.1 FM-MSE is responsible for the technical content of this Criterion and monitoring the applicability and the implementation status of this Criteria and either assisting the organizations that are not applying or meeting the implementation expectations contained herein or elevating their concerns to the director(s).

4.1.2 FM-MSE shall provide technical assistance to support implementation of this Criterion.

4.2 Facility Manager (FM)

4.2.1 Responsible for operations and maintenance of institutional, or Real Property and Installed Equipment (RP&IE) under their jurisdiction, in accordance with the requirements of this document.

4.2.2 Responsible for operations and maintenance of those Personal Property and Programmatic Equipment (PP&PE) systems and equipment addressed by this document that may be assigned to the FM in accordance with the FMU-specific Facility/Tenant Agreement.

4.3 Group Leader

4.3.1 Responsible for operations and maintenance of those Personal Property and Programmatic Equipment (PP&PE) systems and equipment addressed by this document, which are under their jurisdiction.

4.3.2 Responsible for system performance analysis and subsequent replacement or refurbishment of assigned PP&PE.

4.4 ENV-WQH Water Quality and Hydrology

4.4.1 Responsible for monitoring waste streams (outfalls) and overseeing the NPDES permit program.

4.5 ENV-MAQ Air Quality

4.5.1 Responsible for air quality compliance and ambient air monitoring. For gas boiler replacements or upgrades the State of New Mexico stipulates air quality requirements for activities that increase air emissions. As a result, it is necessary to contact ESH-17 to ensure compliance with state regulations and LANL's Air Quality LIR 404-10-01 if a gas boiler (s) upgrade or replacement is planned.

5.0 PRECAUTIONS AND LIMITATIONS

5.1 Precautions

This section is not intended to identify all applicable precautions necessary for implementation of this Criterion. A compilation of all applicable precautions shall be contained in the implementing procedure(s) or work control authorization documents. The following precautions are intended only to assist the author of a procedure or work control document in the identification of hazards/precautions that may not be immediately obvious.

- 5.1.1** Due to liability issues that could arise the initial start-up and check out of new replacement boilers should be performed by factory representatives of said boilers.
- 5.1.2** Material Safety Data Sheets (MSDS) must be kept with boiler chemicals. Chemicals in use should be properly secured next to the chemical injector pumps that feed steam boilers. Store chemicals properly to avoid spills.

5.2 Limitations

The intent of this Criterion is to identify the minimum generic requirements and recommendations for SSC operation and maintenance across the Laboratory. Each user is responsible for the identification and implementation of additional facility specific requirements and recommendations based on their authorization basis and unique equipment and conditions, (e.g., equipment history, manufacturer warranties, operating environment, vendor O&M requirements and guidance, etc.).

Nuclear facilities and moderate to high hazard non-nuclear facilities will typically have additional facility-specific requirements beyond those presented in this Criterion. Nuclear facilities shall implement the requirements of DOE Order 433.1 (Ref. 10.3) as the minimum programmatic requirements for a maintenance program. Additional requirements and recommendations for SSC operation and maintenance may be necessary to fully comply with the current DOE Order or CFR identified above.

6.0 REQUIREMENTS

Minimum requirements that Criterion users shall follow are specified in this section. The Criterion users are responsible for analysis of operational performance and SSC replacement or refurbishment based on their analysis. Laws, codes, contractual requirements, engineering judgment, safety matters, and operations and maintenance experience drive the requirements contained in this section.

6.1 Operations Requirements

- 6.1.1** When starting a boiler, after lay-up, bring pressure and temperature up **slowly**. Stand by boiler until it reaches the established cutout point to make sure the operating control shuts off the boiler. During this period, walk around the boiler frequently to observe that all associated equipment is operating properly. Visually check burner for proper combustion. Following a cold start, condensation (sweating) may occur in a gas-fired boiler to such an extent that it appears that the boiler is leaking. This condensation can be expected to stop after the boiler is hot.

Basis: Work Smart Standard ASME VI 7.02 & 8.02. (For more details on boiler startups, after lay-up, refer to these sections.)

6.2 Maintenance Requirements

Listed below are frequencies for the various routines and tests that shall be performed in connection with the inspection and maintenance of steam /hot water heating boilers. **For “Daily Checks” see 7.1.3**

6.2.1 Weekly (Steam Boilers in Service Only)

- Observe water level at the gage glass, operating pressure, condition of flame and general conditions. Blowdown water column, in gage glass, through the gage glass blowdown valve. This action keeps the water column and piping connections clean and free of sediment or sludge.
- Test the two float-operated low water fuel cut-offs (LWC) by blowing them down, one at a time, while boiler is firing and under pressure. This action not only flushes out any sludge that might accumulate under the float but it also simulates a low water condition, by tripping the mercury switch in the LWC, turning off the burner. It is crucial that the burner turns off immediately during these tests.
- Bottom blowdown.
- Observe condition of condensate feed pump.

Basis: The above maintenance requirements are based on ASME VI 7.07 P (Maintenance Schedule for Steam Boilers.)

- Test water conductivity. Recommended conductivity should range between 1500 and 2800 micromhos/cm (MMHOS). If less than 1500 mmhos decrease continuous blowdown. If more that 2800 mmhos increase continuous blowdown.
- Test boiler water for proper chemical levels. The chemical levels are recommended by the water treatment vendor.
- Test condensate pH. pH levels should range between 7.8 and 9.0.
- Observe condition of chemical container and chemical injector pump.

Basis: The above maintenance requirements are based on recommendations from a reputable water treatment company, as noted in the water treatment section (9.03) of ASME VI. (Reference 10.15) Proper boiler water treatment is one of the most important factors contributing to extending the life of a steam boiler. Untreated water can cause scale, corrosion and pitting of tubes and tubesheets. Chemical formulations listed above are some of those in use as of the date of this document.

Note: Additional water treatment may be required on some steam boilers. As an example, the 100% make-up water required for the high-pressure “process” steam boilers at TA 55-6 is first pretreated by passing the make-up water through a water softener and then preheated in a deaerator. In this particular system the condensate in not returned to the boilers.

6.2.2 Semi-Annually (Fall & Spring on Steam/Hot Water Heating Boilers in Service)

- Observe water level and operating pressure in steam boilers or temperature and operating pressure in hot water heating boilers and general conditions. Fire and cycle boiler. The burner should start smoothly without unusual noises. Visually inspect combustion. Changes in flame shape, color and sound are among early indicators of potential combustion-related problems. Changes may be due to changes in fuel pressure or gas/air linkage movement. Check gas/air linkages, on power burner that modulate, for positioning, tightness and binding. Combustion analysis is verifiable only with a flue gas analyzer and is performed mainly on boilers with power burners.
- Inspect fuel supply system and gas controls. Leak check gas controls and associated gas piping with a gas detector or soap suds.
- Test float-operated low water fuel cut-off (LWC) by blowing it down while the boiler is firing and under pressure. Steam boilers, unlike hot water heating boilers, have two of these devices. This procedure not only flushes-out any sludge that might accumulate under the float but it also simulates a low water

condition, by tripping the mercury switch in the LWC, turning off the burner.

Note: On hot water heating boilers it may be necessary to trip the float assembly linkage manually, after blowing down the LWC, to make the mercury switch trip. This is done because a hot water boiler is full of water and will not always trip the mercury switch in the LWC, like a steam boiler will, when the LWC is blown down. Remove the cover on top of the LWC to access the float assembly linkage. It is crucial that the burner shuts off immediately after these tests.

- Test safety/safety relief valve. (Try Lever Test) Manually open the valve by lifting up on the handle while boiler is under pressure. Water or steam should flow when this is done and should shut off completely when the handle is released. Some boilers have two of these devices.

Note: The discharge from these valves is under pressure and is at high temperatures. Exercise caution to avoid personnel injury or injury to others.

- Observe the operation of operating control. Operating controls start, stop and modulate some burners (if desired) in response to the systems demand, keeping steam pressure or hot water temperature at or below controller setting.
- Test limit control.
- Test flame detection devices on boilers with flame scanners. Remove the flame scanner with the burner firing. The burner should shut off as a flame failure condition. Clean the flame scanner, reinstall and reset programmer. Check for proper operation as boiler goes through a firing cycle and light off.
- Check all electrical controls and circuitry. Careful inspection may disclose any of the following items: cracked mercury tubes, separation of mercury, cracked insulators, jumpered conditions, loose connections, poor or deteriorated wiring and foreign matter.
- Observe condition of condensate or expansion tank. A waterlogged expansion tank will cause the safety relief valve, on a hot water heating boiler, to relieve every time that it fires. This causes the introduction of makeup water, causing a dilution of the water chemistry in a treated system. Drain expansion tank if it is of a non-bladder type and refill to reestablish an air cushion.
- Observe operation of condensate or circulating pumps. Lubricate pump motors if they are of the type that needs lubrication. (Reference Criterion 510, Electric Motor Maintenance)

- Observe operation of forced draft fan motors on boilers with power burners and induced draft fan motors on horizontal breeching where applicable. (**See Section 3.2 Definitions “Induced-Draft Fan”**) Lubricate fan motors if they are of the type that needs lubrication. (Reference Criterion 510, Electric Motor Maintenance)
- Check condition of heating surfaces. (Example: leaking handhole covers, hot spots, etc.)
- Check combustion air supply openings to ensure that they are not closed or stopped up.
- Inspect condition of stacks and rain caps.

Basis: The above maintenance requirements are based on ASME VI 7.07P/8.07P (Maintenance Schedules). **Note:** Due to LANL boiler maintenance experience and a variance granted in the past, the “monthly” maintenance frequencies recommended by ASME VI, are performed semi-annually instead. Procedures for some of the “tests” mentioned above are found in Exhibit C (Tests) of ASME VI. (Ref. 10.7), and Low Pressure Boilers, Third Edition. (Ref. 10.17)

6.2.3 Annually (Summer)

6.2.3.1 Waterside Preventative Maintenance (All Steam Boilers)

- Lockout/Tagout boiler and shut-off gas supply.
- On most steam boilers with power burners swing open front and rear flue doors. Inspect tube sheets for water leakage. The narrow ligaments between tube holes are subject to tremendous stresses and should be watched for any sign of cracking mainly due to overheating.
- Drain steam boiler and remove all handhole and manhole covers, where applicable, to allow a visual check of all internal accessible areas. Example: shell, tubes and tube sheets
- Carefully examine waterside surfaces using a strong light and mirror where required. Look for evidence of scale, corrosion, blisters, or pitting, indicating adequacy of water treatment.
- Use a high-pressure hose to wash sediment out of the bottom and other internals of the boiler.

- Remove heads from the bodies of the float-operated low water fuel cut-offs (LWC). The float-assembly and mercury switches are located on these heads. Flush out LWC bodies. Inspect floats and replace if necessary. Reinstall heads. Remove caps from the inspection crosses associated with both LWCs and flush out piping connected to boiler. Reinstall caps.
- On steam boilers remove pigtail loops from between boiler and pressure control devices. Clean and reinstall.

Basis: The above maintenance requirements are based of LANL boiler maintenance experience and work smart standard ASME VI 7.07P/8.07 P (Maintenance Schedules). Yearly attention to boiler waterside surfaces helps ensure safe, reliable and efficient operation. Inspection of these surfaces can identify water treatment conditions before they become expensive problems.

6.2.3.2 Fireside Preventative Maintenance (Steam/Selected Hot Water Boilers).

Note: These selected hot water boilers are mainly boilers with power burners that have refractory in front and rear flue doors or have heat extractors in the firetubes as are found in most one-pass boilers (Sellers). Steam and hot water heating boilers with atmospheric burners generally require minimal fireside preventative maintenance.

- Routine burner maintenance. Check gas burners for presence of dirt, lint, or foreign matter. Be sure ports, gas passages and air passages are free of obstructions. Check gas/air linkages and moving parts on power burners that modulate, for positioning, tightness and binding. Also check pilot burners and ignition equipment for proper condition and adjustment.
- Check the fireside of furnace and firetubes for any evidence of soot formation or corrosion. Evidence of soot formation is a sign of improperly adjusted combustion. Brush and vacuum furnace and firetubes if such conditions exist. On one-pass boilers (Sellers), if in place, check condition of all heat extractors. These devices can be pulled out individually from each of the firetubes and cleaned if necessary. Check refractory materials, if in place. Repair or replace if necessary.
- Check flue door gaskets and other gaskets to make sure that they are in good condition and that they are properly secured. Replace if necessary. An ineffective seal may allow flue gases to escape into the boiler room and result in burned gaskets and warped flue doors.

- After the fireside and waterside surfaces have been inspected and work completed, close flue doors and re-install handhold and manhold covers if applicable. Hook up all associated piping and refill boiler. Fire-up boiler and check for air, gas and water leaks.

Basis: The above maintenance requirements are based on LANL boiler maintenance experience and work smart standard ASME VI 7.07P/8.07P (Maintenance Schedules). Yearly attention to boiler fireside surfaces helps ensure safe, reliable and efficient operation.

7.0 RECOMMENDATIONS AND GOOD PRACTICES

The information provided in this section is recommended based on acceptable industry practices and should be implemented by each user based on his/her unique application and operating history of the subject systems/equipment.

7.1 Operations Recommendations

- 7.1.1** Boiler Start-Ups, after summer lay-up, should be completed by October 10th of each year. Once boilers have been checked out and put into service reactivate boiler scam alarms by calling Utilities Control Center.

Basis: Engineering Judgement: Experience at LANL has shown that hard freeze conditions can occur by this date.

- 7.1.2** Boiler Lay-ups, for the Summer, should not be started sooner than May 10 of each year. Once idle boilers have been secured for the summer (See **Section 3.2 Definitions “Boiler Lay-up”**) deactivate scam alarms by calling Utilities Control Center. **Note:** Some systems require that their boilers operate year round.

Basis: LANL boiler maintenance experience.

- 7.1.3** It is recommended that building managers, or their designees, check operating boilers daily, in their buildings, during the workweek. Observe water levels, operating pressures, temperatures and general conditions. Determine the cause of any deviation from expected values, unusual odors, noises, or conditions.

Basis: Work Smart Standard ASME VI 7.07P/8.07P (Maintenance Schedules)

- 7.1.4** It is recommended that a permanent logbook be provided in each boiler room to record maintenance work, inspections, certain tests and other pertinent data.

Basis: Work Smart Standard ASME VI 6.09B

- 7.1.5** It is recommended that a National Board Third Party Inspector externally inspect all steam and hot water boilers annually.

Basis: LANL boiler maintenance experience.

7.2 Maintenance Recommendations

- 7.2.1** It is recommended that maintenance personnel engaged in the operation and maintenance of boilers hold a “Certificate of Competence” issued by the State of New Mexico Construction Industries Division, Regulation and Licensing Department.

Basis: State of New Mexico, Construction Industries Division, Rules and Regulations for Boilers, 1998.

- 7.2.2** Boiler trouble calls, especially from “nuisance” boilers that are being reset on a regular basis, should be responded to by qualified maintenance personnel after the second reset.

Basis: LANL boiler maintenance experience

- 7.2.3** It is recommended that boiler “spare parts” be kept on hand for emergencies. Example: programmers, programmer/amplifier modules, blower motors, ignition electrodes, mod motors, cam springs, gas valve actuators, safety relief/safety valves, etc.

Basis: Work Smart Standard ASME VI 6.09 A and LANL boiler maintenance experience.

- 7.2.4** Generally, a neat boiler room indicates a well-run plant. The boiler room should be kept free of all material and equipment not necessary to the operation of the heating system. Good housekeeping should be encouraged and procedures should include routine inspections to maintain the desired level of cleanliness.

Basis: Work Smart Standard ASME VI 6.07.

- 7.2.5** It is recommended to annually test water in Hot Water Heating Boilers for proper chemical levels. Chemical levels (Garrett-Callahan formula 1015L or alternate treatment determined to be appropriate) should range between 8-10 ppm.

EXCEPTION: Water in boilers used for domestic purposes only, and not for heating, is not treated. Example: The water in the system of BHW-2, at TA 18-31, is not treated.

Basis: The above maintenance recommendation is based on LANL boiler experience and recommendations from reputable water treatment companies. (Reference 10.15) The introduction of makeup water to

replace that lost (leaks) or removed from the system causes a dilution of the water chemistry in a treated system. Proper boiler water treatment is one of the most important factors contributing to extending the life of a boiler. Untreated water can cause scale, corrosion and pitting of tubes and tubesheets. Chemical formulations listed above are those in use as of the date of this document.

- 7.2.6** If need be, obtain the services of an outside ASME certified boiler service company for major emergency repairs, such as re-tubing a boiler, tubesheet repairs, etc. There are several of these companies in Albuquerque, N.M. and are licensed by the State of New Mexico, Construction Industries Division. (Reference 10.16) Most of these companies provide 24 hour emergency service. They also do combustion analysis and tuning of burners for greater combustion efficiency.

Basis: LANL boiler maintenance experience.

- 7.2.7** Boilers over 25 years old should be prime candidates for replacement. The FM-MSE Boiler SME is available to assist in “aging boiler” replacements.

8.0 GUIDANCE

8.1 Operations Guidance

- 8.1.1** It has always been Hartford Steam Boilers (Insurance Company) contention that there is no substitute for a good boiler PM and testing program conducted by a qualified service organization and the employment and continuous training of qualified boiler operators. Whether a state has boiler laws or not, it is the owners responsibility to see that his equipment receives this necessary attention.

8.2 Maintenance Guidance

- 8.2.1** Provided it has been reviewed and approved by FM-MSE, an acceptable program for boiler inspection may be found in KSL preventative maintenance instruction PMI 40-40-003, Boiler Preventative Maintenance & Repair. (Reference 10.18)

9.0 REQUIRED DOCUMENTATION

Maintenance history shall be maintained for boiler systems to include, as a minimum, the parameters listed in the Table 9-1 below:

Table 9-1 Documentation Parameters

MAINTENANCE HISTORY DOCUMENTATION PARAMETERS				
PARAMETER	ML 1	ML 2	ML 3	ML 4
Manufacturer's Name Plate Data	X	X	X	X
Maintenance Activities				
Repair / Adjustments	X	X	X	X
PM Activities	X	X	X	X
Replacement (includes dates)	X	X	X	X
Equipment Problems				
Failure Dates	X	X	X	
Failure Root Cause	X	X	X	
Inspection Results				
Inspection Date(s)	X	X	X	X
SSC Condition	X	X	X	
Test the two float-operated low water cut-offs (6.2.1)	X	X	X	
Test water conductivity (6.2.1)	X	X	X	
Test boiler water for proper chemical levels (6.2.1)	X	X	X	
Test condensate pH (6.2.1)	X	X	X	
Test float-operated low water cut-offs (6.2.2)	X	X	X	
Test safety/safety relief valves (6.2.2)	X	X	X	
Test limit control (6.2.2)	X	X	X	
Test flame detection devices (6.2.2)	X	X	X	

Basis: Documentation of the parameters listed in Table 9-1 above satisfies the requirements of LPR 230-07-00, Criteria 2, (Ref. 10.5) which states; "Maintenance activities, equipment problems, and inspection and test results are documented."

10.0 REFERENCES

- 10.1** LIR 230-05-01.0, Operation and Maintenance Manual.
- 10.2** DOE O 430.1A, Attachment 2 “Contractor Requirements Document” (Paragraph 2, Sections A through C), a requirement of Appendix G of the UC Contract.
- 10.3** DOE Order 433.1, Maintenance Management Program, for DOE Nuclear Facilities.
- 10.4** LIR 301-00-02.0, Variances and Exceptions to Laboratory Operation Requirements.
- 10.5** LPR 230-07-00, Maintenance History, Performance Criteria [2].
- 10.6** LIR 404-01-01.1, Air Quality Reviews.
- 10.7** ASME Section VI. (Recommended Rules for the Care and Operations of Heating Boilers), 1998.
- 10.8** ASME CSD-1-1998. (Controls and Safety Devices for Automatically Fired Boilers).
- 10.9** National Board Inspection Code, 1995.
- 10.10** State of New Mexico, Construction Industries Division, Rules and Regulations for Boilers, 1998.
- 10.11** Uniform Mechanical Code, 1997.
- 10.12** Various Manufacturer’s Operations and Maintenance Manuals. Examples: Cleaver-Brooks Model CB Package Boilers, Manual Part No. 750-91; Sellers Immersion Fired Boilers, Bulletin No. 8100 10-91 and others.
- 10.13** Standard Heating and Power Boiler Plant Questions & Answers, Elonka & Kohan, 1984.
- 10.14** Boilers, An Operators Workshop, National Technology Transfer, Inc, 1998.
- 10.15** Garrett-Callahan. (A water treatment service company from Albuquerque).
- 10.16** Chardan’s Boiler Service, Welch’s Boiler Service, A-1 Boiler Service, etc.
- 10.17** Low Pressure Boilers, Third Edition, Frederick M. Steingress, 1994
- 10.18** PMI 40-40-003, “Boiler Preventative Maintenance & Repair.”

11.0 APPENDICES

None.